

CLAIMS

1. Method for controlling a shift from a first mode to a second mode in a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor, first mode operation characterized by simultaneous first torque transfer device applied and second torque transfer device released, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied, neutral mode operation characterized by simultaneous first and second torque transfer devices released wherein the transmission output member is mechanically decoupled from the transmission, and fixed-ratio operation characterized by simultaneous first and second torque transfer devices applied wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, comprising:
 - while in one of the first and second modes, releasing the one of the first and second torque transfer devices that is applied to establish neutral mode operation;
 - controlling slip speed across one of the first and second torque transfer devices to substantially zero; and,
 - applying the one of the first and second torque transfer devices across which slip is being controlled when the slip thereacross is substantially zero.

2. The method for controlling a shift as claimed in claim 1 wherein controlling slip speed across the one of the first and second torque transfer devices is accomplished by adjusting motor torque.

3. The method for controlling a shift as claimed in claim 2 wherein controlling slip speed terminates when the one of the first and second torque transfer devices across which slip is being controlled is fully applied.

4. The method for controlling a shift as claimed in claim 1 further comprising:

5 establishing a substantially zero torque at the output member immediately in advance of releasing the one of the first and second torque transfer devices.

5. The method for controlling a shift as claimed in claim 4 further comprising:

5 establishing a substantially non-zero torque at the output member immediately subsequent to the application of the one of the first and second torque transfer devices.

6. The method for controlling a shift as claimed in claim 1 wherein the shift is initiated in response to a ratio violation.

7. The method for controlling a shift as claimed in claim 1 wherein the shift is initiated in response to a rate of change of output member speed in excess of a predetermined amount.

8. Method for controlling a shift from a first mode to a second mode in a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor, first mode operation characterized by simultaneous first torque transfer device applied and second torque transfer device released, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied, neutral mode operation characterized by simultaneous first and second torque transfer devices released wherein the transmission output member is mechanically decoupled from the transmission, fixed-ratio operation characterized by simultaneous first and second torque transfer devices applied wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, and a preferred operating region for first mode

operation on one side of the fixed ratio and a preferred operating region for the
 15 second mode of operation on the other side of the fixed ratio, comprising:
 when one of the first and second modes of operation is active
 within the preferred operating region for the other of the first and second
 modes of operation, executing a shift through the neutral mode comprising;
 reducing output member torque to substantially zero,
 20 releasing the one of the first and second torque transfer devices
 that is applied,
 determining which of the first and second modes is desired,
 controlling to substantially zero the slip speed across the one of
 the first and second torque transfer devices which when applied
 25 establishes the desired one of the first and second modes,
 applying the one of the first and second torque transfer devices
 that will establish the desired one of the first and second modes, and
 increasing output member torque to non-zero.

9. The method as claimed in claim 8 wherein reducing output
 torque to substantially zero includes ramping output torque at a predetermined
 rate.

10. The method for controlling a shift as claimed in claim 8
 wherein controlling slip speed is accomplished by adjusting motor torque.

11. Method for controlling a shift from a first mode to a second
 mode in a multi-mode, electro-mechanical transmission including an input
 member and an output member, first and second torque transfer devices, at
 least one motor, first mode operation characterized by simultaneous first
 5 torque transfer device applied and second torque transfer device released,
 second mode operation characterized by simultaneous first torque transfer
 device released and second torque transfer device applied, neutral mode
 operation characterized by simultaneous first and second torque transfer
 devices released wherein the transmission output member is mechanically

- 10 decoupled from the transmission, fixed-ratio operation characterized by
simultaneous first and second torque transfer devices applied wherein the
transmission input member is mechanically coupled to the transmission output
member through a fixed ratio, and a preferred operating region for first mode
operation on one side of the fixed ratio and a preferred operating region for the
15 second mode of operation on the other side of the fixed ratio, comprising:
when the first mode of operation is active within the preferred
operating region therefor and the output member experiences a rate of change
of speed in excess of a preset threshold, executing a shift through the neutral
mode comprising;
20 releasing the first torque transfer device,
controlling slip speed across the second torque transfer devices to
substantially zero, and
applying the second torque transfer device when the slip speed of
the torque transfer device is substantially zero.

12. The method for controlling a shift as claimed in claim 11
wherein controlling slip speed across the second torque transfer device is
accomplished by adjusting motor torque.